

# MIL-PRF-19500 Appendix J Task Group Summary Status to CE-12 Committee

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# MIL-PRF-19500 Appendix J Status

- MIL-PRF-19500 Revision R with Appendix J released on July 24, 2021.
- There are eleven non hermetic slash sheets in development. Three nonhermetic slash sheets have been released as drafts. Slash sheets waiting on couple of items to be resolved.
  - Review of JEDEC ballot survey responses for glass transition temperature test method for this characterization process.
  - Epoxy encapsulant over glass construction in regards to:
    - Is TM5011 still required?
    - Is sequential testing required?
    - Glass transition temperature testing – can it be moved from Appendix J Group B to Group C testing?

# Planned slash sheets for Appendix J Qualification

19500 Slash sheet	Device Type	Part number	Additional information
672	NPN Silicon Switching Transistor	2N2222	Cross references to hermetic /255
674	NPN Silicon LowPower Transistor	2N2484	Cross references to hermetic /376
686	PNP Silicon Switching transistor	2N2907	Cross references to hermetic /291
691	Silicon switching diode		Cross references to hermetic /116
694	NPN Silicon LowPower Transistor	2N3700	Cross references to hermetic /391

# Planned slash sheets for Appendix J Qualification

19500 Slash sheet	Device Type	Part number	Additional information
695	PNP Silicon Switching transistor	2N4033	Cross references to hermetic /512
696	N-Channel Power MOSFET		
714	N-Channel Power MOSFET	2N7558 – 2N7560	
715	N-Channel Power MOSFET	2N7563 – 2N7565	
716	Unipolar Transient Voltage Suppressor diode	1N5555 and others	Cross references to hermetic /500
717	Bipolar Transient Voltage Suppressor diode	1N6036 – 1N6072	Cross references to hermetic /507

## Appendix J JEDEC JC13.1 Ballot on Glass Transition Temperature Test Methods

- Task group discussed the Glass transition temperature issue and following observations was made.
- Three (3) general techniques utilized for Glass Transition Temperature Measurement (Tg):
  1. Differential Scanning Calorimetry (DSC)
  2. Thermal Mechanical Analysis (TMA)
  3. Dynamic Mechanical Analysis (DMA)

# Appendix J JEDEC JC13.1 Survey Ballot on Glass Transition Temperature Test Methods Utilized



## TASK GROUP SURVEY FROM: MIL-PRF-19500 Appendix J

**Number:** 001

**Dated:** 11/16/21

**Survey Period:** 11/22/21 – 12/22/21

**Background:** This survey is being submitted to JC14 and JC13.1 committee members to collect inputs for the 19500 Appendix J Task Group. Results of this survey will be reviewed in the January 2022 JEDEC meeting.

One of the discrete semiconductor manufacturers that is in the process of qualifying their first nonhermetic encapsulated military qualified discrete semiconductor has found that there are no test laboratories using the ASTM E1640 Glass Transition (Tg) Temperature Measurement Test method. The manufacturer brought their concerns to the 19500 Appendix J task group for assistance in determining the glass transition temperature test method utilized by most nonhermetic encapsulated semiconductor manufacturers.

Questions	Responses	Comments
1. Which glass transition temperature test method does your facility or test laboratory utilize/use to characterize and monitor glass transition, Tg?		
2. How is the glass transition temperature testing performed? a. On finished product samples? b. Or on raw material samples?		
3. What is the frequency of glass transition testing?		
4. How is epoxy mold compound accepted (e.g., certificate of conformance, receiving inspection test, rely on product testing)?		

# JEDEC JC13.1 Ballot on Glass Transition Temperature Test Methods Response Summary (Cont.'d)

- There were a total of 8 responses.

- Six no comment responses.
  - Two comment responses.

# JEDEC JC13.1 Ballot on Glass Transition Temperature Test Methods Response Summary (Cont.'d)

Questions	Responses	Comments
1. Which glass transition temperature test method does your facility or test laboratory utilize/use to characterize and monitor glass transition, Tg?	Both TMA and DMA. In the TMA this is determined by the inflection point between the region below and above Tg. In the DMA it is based on the onset of the transition from the storage modulus curve.	In line with ASTM E1640
1. How is the glass transition temperature testing performed? a. On finished product samples? b. Or on raw material samples?	On raw material samples of specified geometry	
1. What is the frequency of glass transition testing?	During development and on incidental basis. The supplier monitors this data on supplier batches as per the agreed frequency	
1. How is epoxy mold compound accepted (e.g., certificate of conformance, receiving inspection test, rely on product testing)?	Certificate of conformance	

# JEDEC JC13.1 Ballot on Glass Transition Temperature Test Methods Response Summary (Cont.'d)

- Second comment response is as follows:
- Comments: (5-2) Comment(s) on survey: We currently do not make any product that would be covered under this survey. However, we would be okay to move forward with ASTM E1640 as the base standard to move forward.

# External Visual Test Method Comparison

Visual Criteria	JESD22-B101C	MIL-STD-750-2 TM2071
Dry gas blow off or vacuum particle removal	Allowed	No provision
Magnification	With unaided eye or 3X – 7X	20X minimum
Uncertain observation magnification	Up to 30X	40X maximum, higher magnification may be used to further examine anomaly
Contamination	Yes	Yes
Nonconforming dimensions	Yes	Yes(?)

# External Visual Test Method Review (Cont.'d)

Visual Criteria	JESD22-B101C	MIL-STD-750-2 TM2071
Marking	Illegible characters, deformed broken, faint, missing, extraneous marks, doubled, wrong	Yes (laser marking only)
Leads	Yes	Yes
Lead finish	Yes	Yes
Package finish	No	Yes
Molding and mold compound	Yes	No
Solder balls	Yes (?)	No

## External Visual Test Method Review (Cont.'d)

Visual Criteria	JESD22-B101C	MIL-STD-750-2 TM2071
Substrate	Yes	No
Exposed backside Silicon	Yes	No
Ceramic packages	No	Yes
Transparent glass packages	No	Yes
Hermetic packages	?	Yes
Critical sealants	Yes	No
Attachments	Yes	No (?)
Foreign Material	Yes	Yes

# MIL-PRF-19500 Appendix J Task Group Summary

- MIL-PRF-19500 Revision R with Appendix J for nonhermetic devices was dated on 24 July 2021.
- Three draft nonhermetic slash drafts released by DLA to date:
  - MIL-PRF-19500/672 – Nonhermetic version of the 2N2222.
  - MIL-PRF-19500/716 – nonhermetic version of the 1N5555.
  - MIL-PRF-19500/717 – nonhermetic version of the 1N6036-1N6072.
- Eight additional nonhermetic slash sheets planned to be sent out as drafts.
- Further discussion and clarification on the glass transition temperature test method to be used is scheduled for early February.

# MIL-PRF-19500 Appendix J Future Plans

- Continue having regular webex meetings to address test method issues related to Appendix J devices.
  - Glass Transition Temperature measurement method.
  - Continue review of External Visual Inspection test methods: MIL-STD-750-2, test method 2071 and JESD22-B101C.
  - Review is being planned for additional JEDEC and military test methods such as: Acoustic Microscopy, HAST, Autoclave etc.
  - Results of task group test method reviews will be presented to DLA.
- Address epoxy encapsulant over glass construction in regards to TM5011, sequential testing, and/or modifications to the test flow.

# Thank you!

- We would like to express our appreciation to the task group members, NASA NEPAG and SLS programs, Government Working Group, and Microchip Technologies for their continued support of this effort.
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# Acronyms

- AC – Autoclave
- ASTM – American Society for Testing and Materials
- DLA – Defense Logistics Agency
- DPA – Destructive Physical Analysis
- EEE – Electrical, Electronic, and Electromechanical
- EP – Engineering Practice
- HAST – Highly Accelerated Stress Testing
- HTRB – High Temperature Reverse Bias
- IOL – Intermittent Operating Life

# Acronyms

- JAN – Joint Army Navy
- JANP – Joint Army Navy Plastic
- JANPTX - Joint Army Navy Plastic eXtra Testing
- JANPTXV - Joint Army Navy Plastic eXtra Testing with Visual
- JANPS – Joint Army Navy Plastic Space
- JANS – Joint Army Navy Space
- JANTX – Joint Army Navy eXtra Testing
- JANTXV – Joint Army Navy eXtra Testing with Visual
- JEDEC – Joint Electronic Devices Council
- NASA – National Aeronautics and Space Administration

## Acronyms

- NEPAG – NASA EEE Parts Assurance Group
- PEDS – Plastic Encapsulated Discrete Semiconductors
- RH – Relative Humidity
- SAE – Society of Automotive Engineers
- SLS – Space Launch System
- t – time (i.e. t = 96 hours)
- T<sub>g</sub> – Glass Transition Temperature
- T<sub>j</sub> – Junction Temperature
- THB – Temperature Humidity Bias
- TM – Test Method
- UHAST – Unbiased Highly Accelerated Stress Test